AUTOCLAVE MELTOUT OF CAST EXPLOSIVES

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ABSTRACT

Current methods for the disposal of munitions containing cast explosives (TNT, Comp B, and Tritonal) includes Open Burn/Open Detonation (OB/OD), steam out, wash out and contour drilling. Environmental concerns associated with above methods include air and ground contamination and waste stream treatment. Volume, concentration and toxicity variables have a direct correlation to the economics of disposal.

Autoclave meltout is a demilitarization method that reduces the volume of the waste stream, employs basic industrial technology, and produces a product suitable for reuse. This method is currently in use at Hawthorne Army Ammunition Plant (HWAAP), Nevada and Crane Army Ammo Activity (CAAA), Indiana. The Ammunition Equipment Directorate (AED), Tooele Army Depot, Utah is in the process of developing a standard autoclave system. Candidate munitions and explosives are summarized on Vugraph 2.

BACKGROUND

Currently, the Ammo Peculiar Equipment (APE) 1300 Washout Plant is the only APE designed for large scale recovery of cast explosives. This system employs the use of hot water to erode explosives through nose/base plugs of projectiles from 75MM to 2000 pound bombs. The process involves loading the items onto a rack, open end down, then onto a washout tank with the openings positioned over jet nozzles. These nozzles direct 180°F water at 100 psi into the projectile, which erodes the explosive and allows it to drop into the washout tank. Through various tanks, kettles, and pelletizing equipment a usable product was recovered. This process creates large amounts of pink water requiring treatment prior to discharge. Only one APE 1300 Washout Plant is currently operational.

Another method employed at various locations is a steam lance inserted through the nose of the item to melt and erode the explosive. Through unique fixturing, the condensate/explosive mixture is collected and processed through separating/melt kettles and the explosive cast into bricks or flaked. This method also produces large quantities of pink water requiring treatment prior to discharge.

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Ravenna Army Ammo Plant pursued autoclave meltout of projectiles and bombs since the 1960's. This equipment has been reinstalled at CAAA and went operational July 1994. It should be noted that fabrication and installation drawings and operational manuals were practically nonexistent for these excess autoclaves. 175MM projectiles are currently being processed.

HWAAP had autoclave meltout and refining equipment installed in the late 1970's. This system incorporated larger, improved autoclaves, molten explosive collection piping, vacuum treatment melt kettles, flaker belts, and improved material handling equipment in an integrated system. 175MM projectiles are currently being processed.

During the 1976/1977 period, AED investigated various methods of heating of munitions to meltout out cast explosives. Autoclave heating of explosives in sawed projectiles and induction and microwave were all investigated. Induction and microwave heating were abandoned during testing phases as a result of hot spot detonation of the munition. Sawing projectiles in half and then heating to remove a slug of explosive proved safe, but the sawing process was deemed an uneconomical.

With the emphasis on environmental considerations, Armament, Munitions and Chemical Command assigned Ammunition Equipment Directorate (AED) in 1993 the task to develop and field a standard autoclave system. Emphasis was placed on performance, reliability, maintainability and environmental sensitivity to meet the growing workload for demilitarization and anticipation of greater restrictions on OB/OD.

DESCRIPTION OF PROPOSED APE 1401 AUTOCLAVE MELTOUT SYSTEM

AED has visited both operating autoclave facilities to collect performance data, process flow, available fabrication data and recommended improvement information. AED has also visited the proposed first installation site, McAlester Army Ammo Plant, Oklahoma, to discuss proposed workload and inspect available facilities and equipment. The project has progressed into the pilot model production phase with the first test autoclave targeted for fabrication and testing in October 1994.

The autoclave will be similar to those at HWAAP and are shown on Vugraph 3. Emphasis will be placed on fabrication economy and catalog available components. Basic design calls for seamless pipe shells, ASME code heads used for the hinged lid and base, projectile spiders, cooling spray nozzles, and manual and automated controls and timers. The autoclaves will be operated at a maximum 15 psig (240°F) steam pressure. The munitions will be cooked in a melt/drain, vertical position. Molten explosives will be vacuum transferred to melt kettles via steam jacketed collection manifolds. The process flow is shown on Vugraph 4. The final form of the explosive, whether flake, pellet, or cast block, will be determined by the operating facility.

A unique feature proposed for the APE 1401 system is the incorporation of the APE 2306

robot to be used to load/unload the projectiles into the spiders on a rotary index table. Current systems use a air assisted manipulator. Loading/unloading of the spiders into the autoclave will be accomplished with common overhead monorail systems.

Performance of autoclaves on munitions up to 8 inch projectiles has been established at the other locations. However, performance of autoclaves on larger munitions such as the 750 pound general purpose bomb has not been established. This potential requirement will determine features of the test autoclave. Results of the 750 pound bomb test will determine final size and features of the production autoclaves.

The arrangement of the fuse and nose conduit within the 750 pound bomb interferes with normal steam lance insertion. Furthermore, it was anticipated that the hot melt asphaltic compound used to line the bomb cavity would also be removed as a result of steam impingement, contaminating the explosive and clogging of the collection piping and valves. Finally, the large volume of contaminated water generated from steam out has been determined as an unsatisfactory by product of the steam out method.

Proposed method of autoclave meltout of the 750 pound bomb is to remove the nose and base plug from the bomb to allow the insertion of a steam line into the tail fuse liner. Live steam will be introduced through the arming conduit to be exhausted from the nose liner and circulation around the bomb case. As the explosive melts it will drain from the base plug into the collection manifold. Ultimately, the slug of explosive will dropped into the funnel where it will be further melted on the heat exchanger grid to be carried away by the collection manifold system.

Upon completion of the cooking operation, cooling water will be sprayed onto the projectile to reduce residual dripping of explosive as the item is removed. Final disposition of the item is flashing of the projectile/case to remove all traces of explosive and disposal of the metal parts through DRMO.

Anticipated production rates and costs are shown on Vugraph 5. Expected pink water generation is approximately 2.5 pounds per pound explosive.

CONCLUSIONS

Autoclave meltout of cast explosives has been demonstrated as an environmentally sensitive alternative for demil. The development of the APE 1401 and associated test reports, technical data package, operational manuals and personnel experienced with the system will provide DoD facilities a standard system for their operations.

AUTOCLAVE MELTOUT SYSTEM

FOR CAST EXPLOSIVES

Viewgraph 1
Autoclave Meltout System for Cast Explosives

AUTOCLAVE MELTOUT SYSTEM
CANDIDATE EXPLOSIVES AND MUNITIONS

EXPLOSIVES:

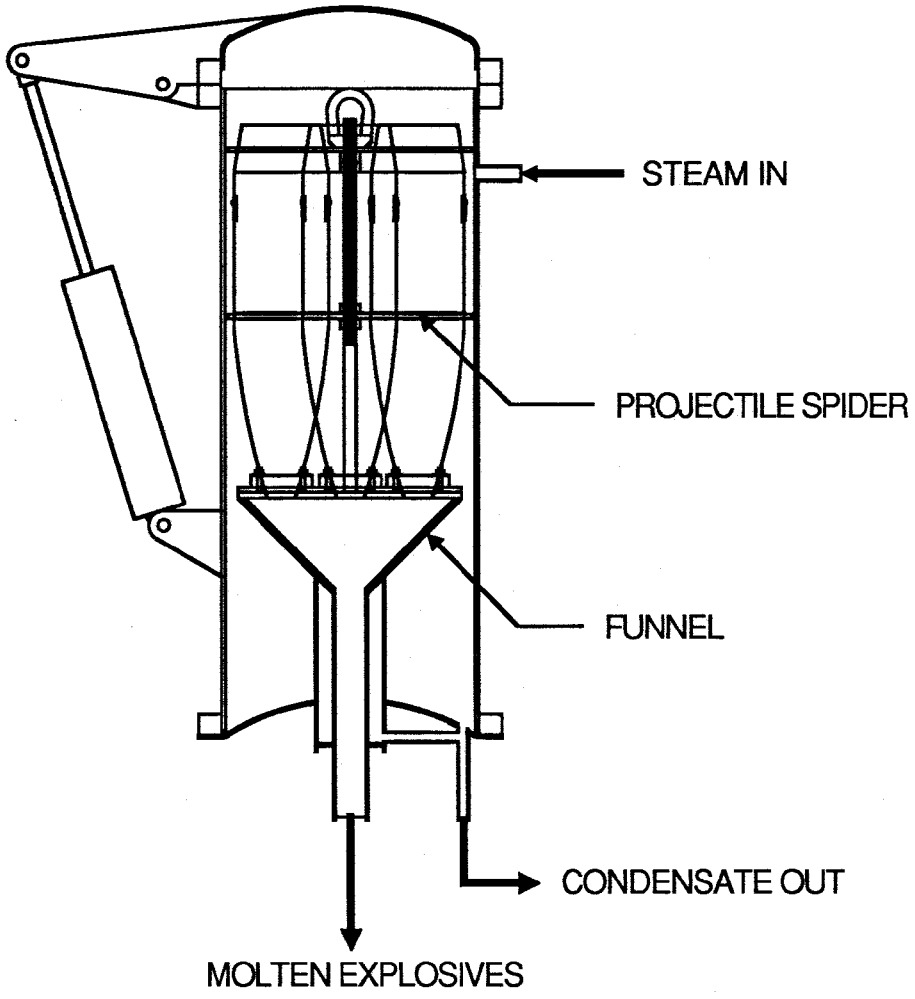
TNT
COMPOSITION B
TRITONAL

MUNITIONS:

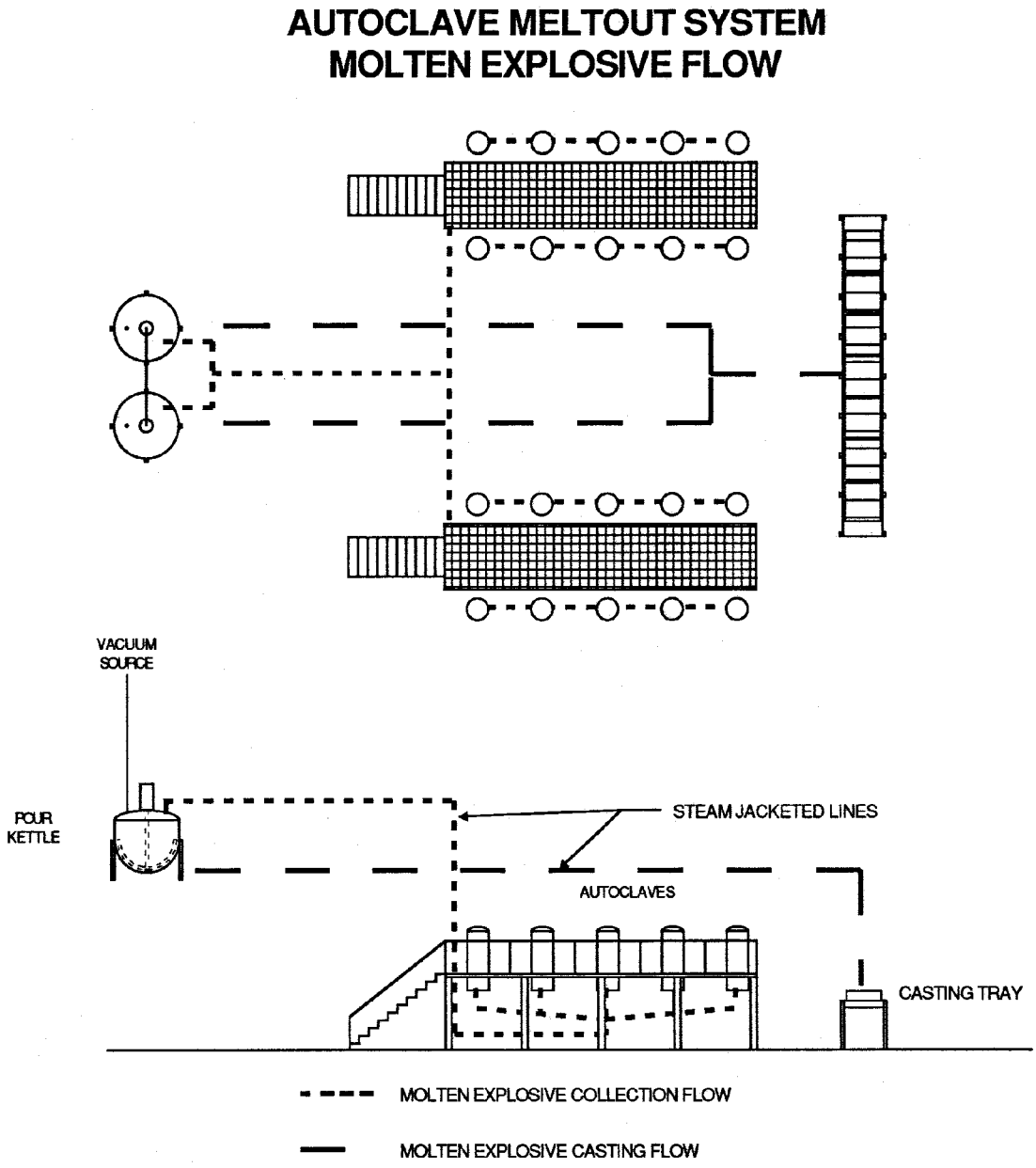
90 MM PROJECTILE
105 MM PROJECTILE
155 MM PROJECTILE
175 MM PROJECTILE
8 IN PROJECTILE
750 LB GP BOMB

Viewgraph 2
Autoclave Meltout System Candidate Explosives and Munitions

AUTOCLAVE MELTOUT SYSTEM
AUTOCLAVE DESIGN CONCEPT



Viewgraph 3
Autoclave Meltout System
Autoclave Design Concept



Viewgraph 4
Autoclave Meltout System
Molten Explosive Flow

AUTOCLAVE MELTOUT SYSTEM PERFORMANCE

PRODUCTION RATE: 100-160 LBS/HOUR PER AUTOCLAVE

AUTOCLAVE COST: $500-$650 PER TON
INCL BREAKDOWN
EXCL DISPOSAL OF EXPLOSIVE

Viewgraph 5
Autoclave Meltout System
Performance